





Mesomeric Effect/Resonance Effect

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Pharm-D

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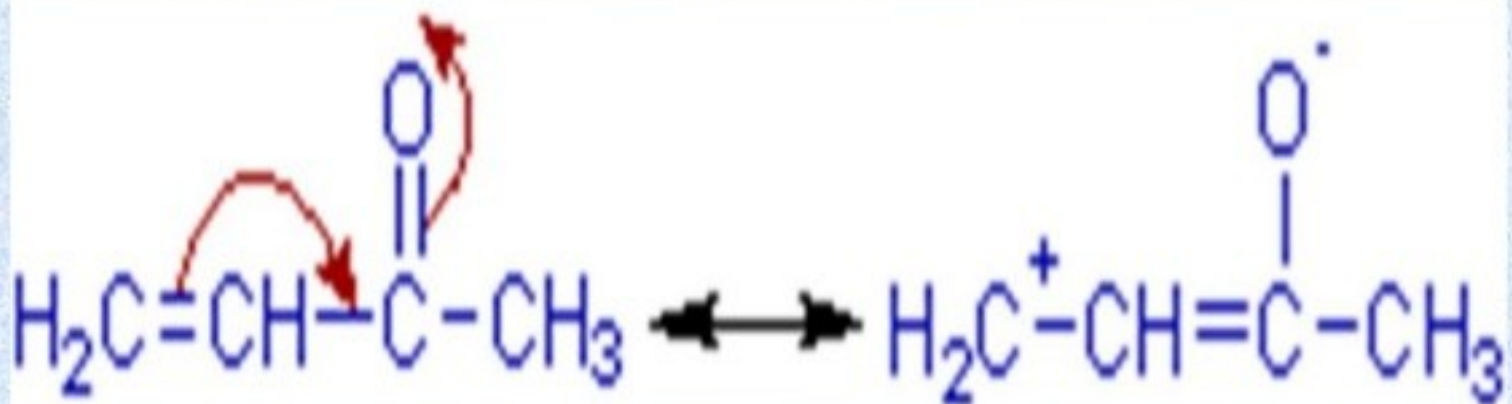
RIPS

INTRODUCTION OF MESOMERISM

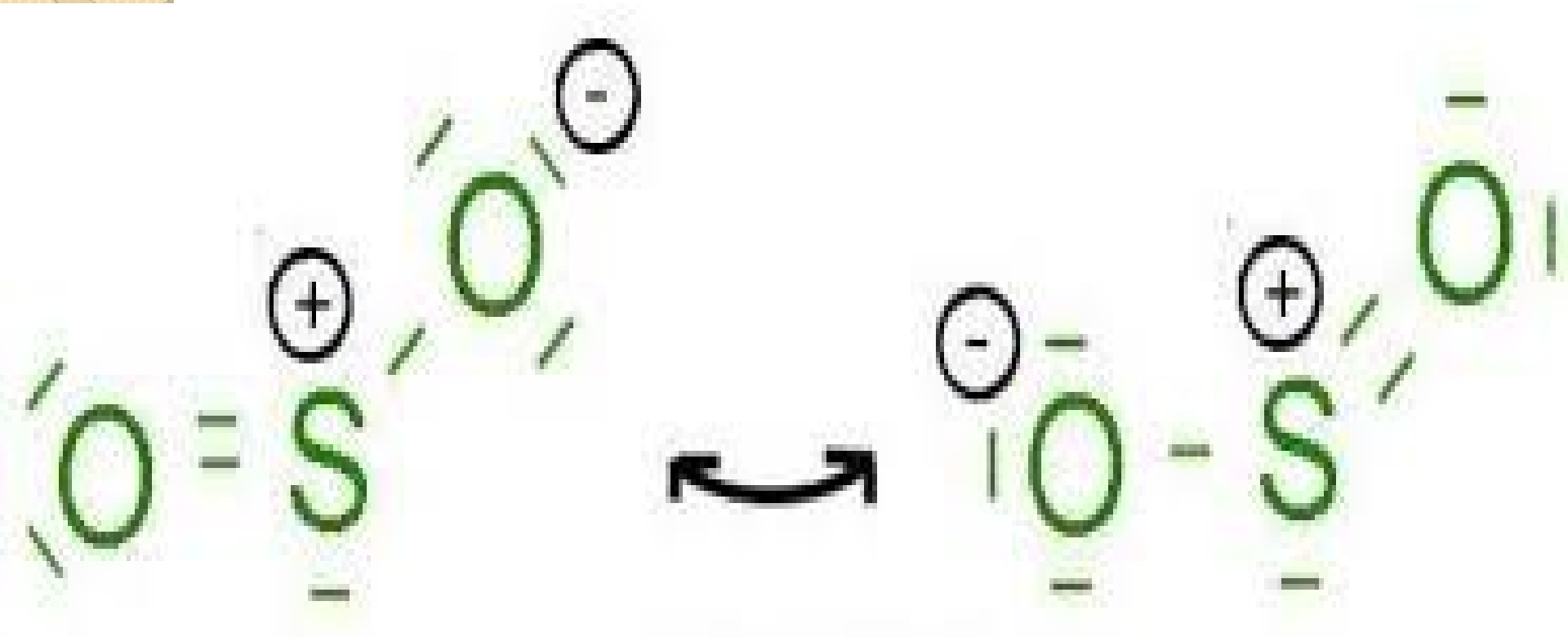
- THE CONCEPT OF MESOMERISM MESOMER AND MESOMERIC EFFECT WERE INTRODUCED BY **INGOLD** IN **1938**.
- IT IS ALSO KNOWN AS **OLD FASHIONED** TERM FOR **RESONANCE**

RESONANCE EFFECT OR MESOMERIC EFFECT :

The mesomeric effect is defined as the polarity produced in the molecule by the interaction of two π bonds or between a π bond and lone pair of electrons present on an adjacent atom. It is symbolized by M or R.



EXAMPLE



this is the formula of **one single** molecule !!

Mesomeric Effect (M-Effect)

- It refers to the polarity produced in a molecule as a result of interaction between two pi bonds or a pi bond and lone pair of electrons.
- The electron withdrawing or releasing effect attributed to a substituent through delocalization of π electrons, which can be visualized by drawing various canonical forms, is known as **mesomeric effect or resonance effect**. It is symbolized by M or R.

TYPES

- Negative mesomeric effect (-M or -R):

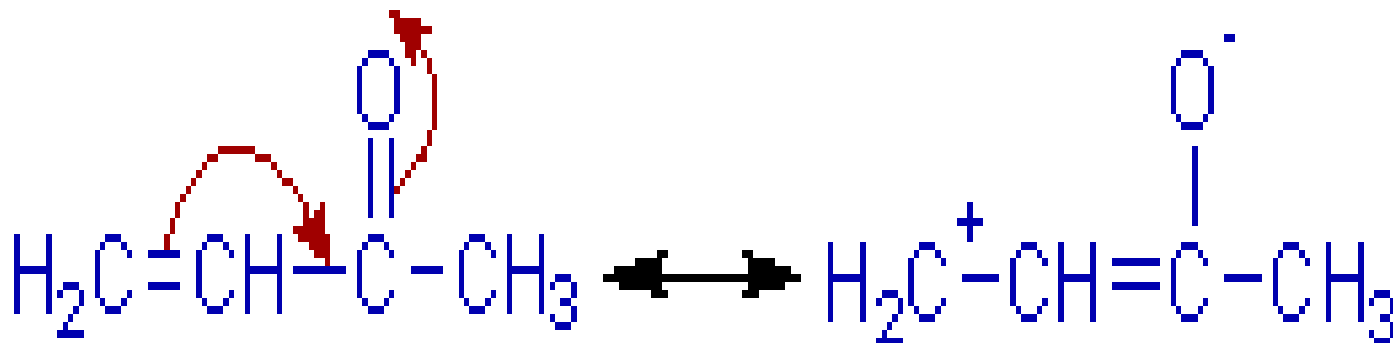
- It is shown by substituents or groups that withdraw electrons by delocalization mechanism from rest of the molecule and are denoted by -M or -R. The electron density on rest of the molecular entity is decreased due to this effect.

- E.g. $-\text{NO}_2$, Carbonyl group ($\text{C}=\text{O}$), $-\text{C}\equiv\text{N}$, $-\text{COOH}$, $-\text{SO}_3\text{H}$ etc.

Negative mesomeric effect (-M or -R):

- Example:

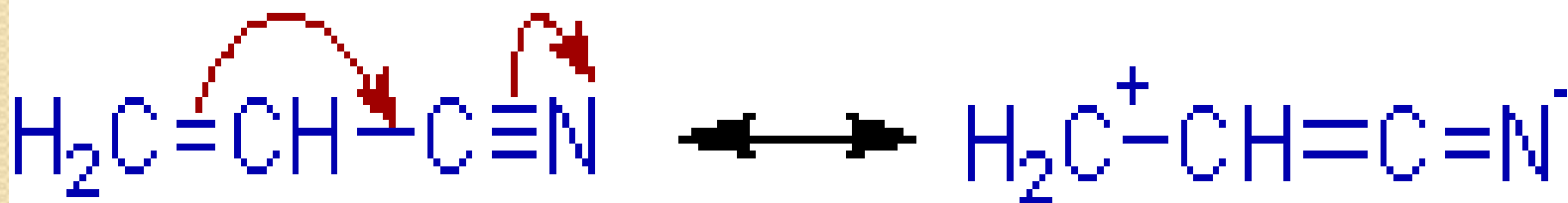
- I) The negative resonance effect (-R or -M) of carbonyl group is shown below. It withdraws electrons by delocalization of π electrons and reduces the electron density particularly on 3rd carbon.



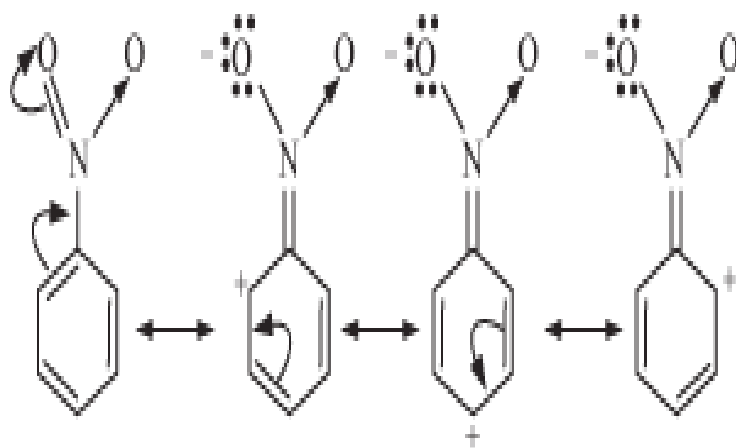
Negative mesomeric effect

(-M or -R):

- 2) The negative mesomeric effect (-R or -M) shown by cyanide group in acrylonitrile is illustrated below. The electron density on third carbon decreases due to delocalization of π electrons towards cyanide group.



Negative Resonance Effect (- R Effect): Transfer of electrons is towards the atom or substituent group attached to the conjugated system.



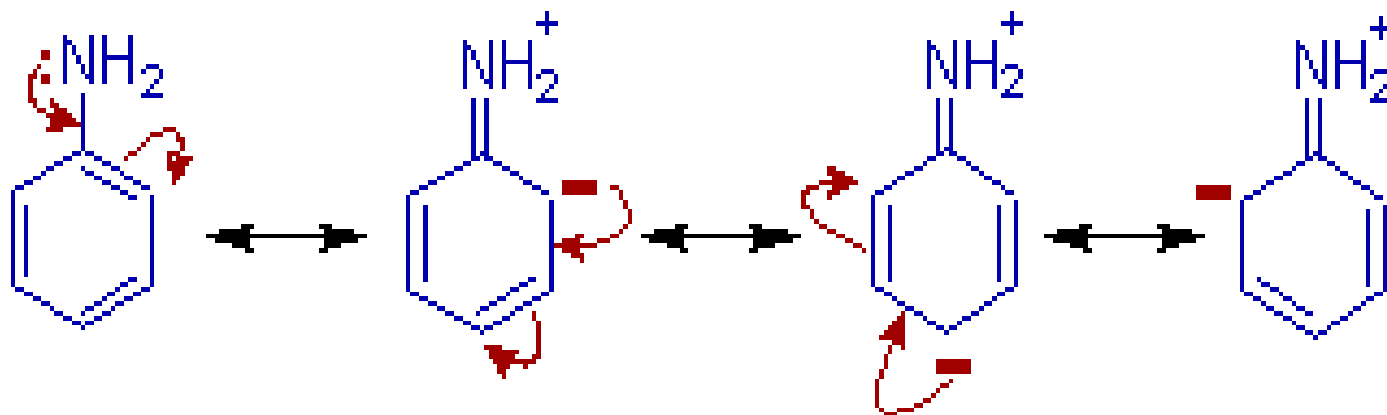
- R effect showing groups: $-\text{COOH}$, $-\text{CHO}$, >C=O , $-\text{CN}$, $-\text{NO}_2$

Positive resonance or mesomeric effect (+M or +R):

- The groups show positive mesomeric effect when they release electrons to the rest of the molecule by delocalization. These groups are denoted by +M or +R. Due to this effect, the electron density on rest of the molecular entity is increased.
- **E.g. -OH, -OR, -SH, -SR, -NH₂, -NR₂ etc**

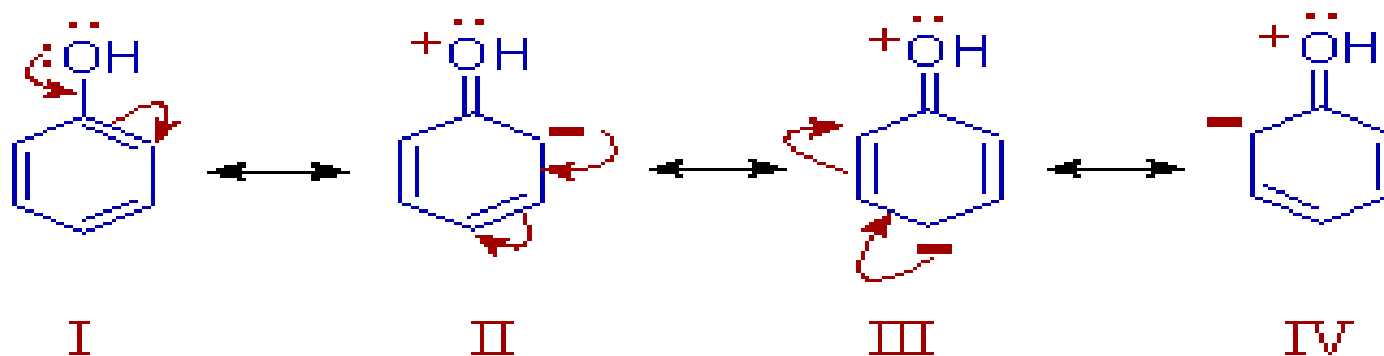
Positive resonance or mesomeric effect (+M or +R):

- The -NH_2 group in aniline also exhibits +R effect. It releases electrons towards benzene ring through delocalization.

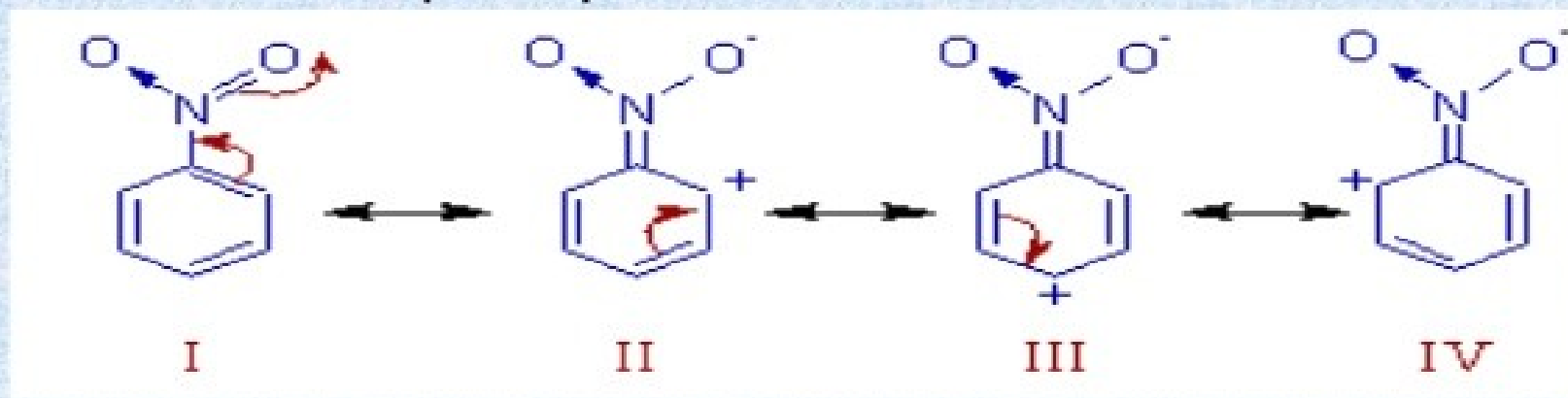


Positive mesomeric effect (+M or +R):

- I). In phenol, the -OH group shows +M effect due to delocalization of lone pair on oxygen atom towards the ring. Thus the electron density on benzene ring is increased particularly on ortho and para positions.

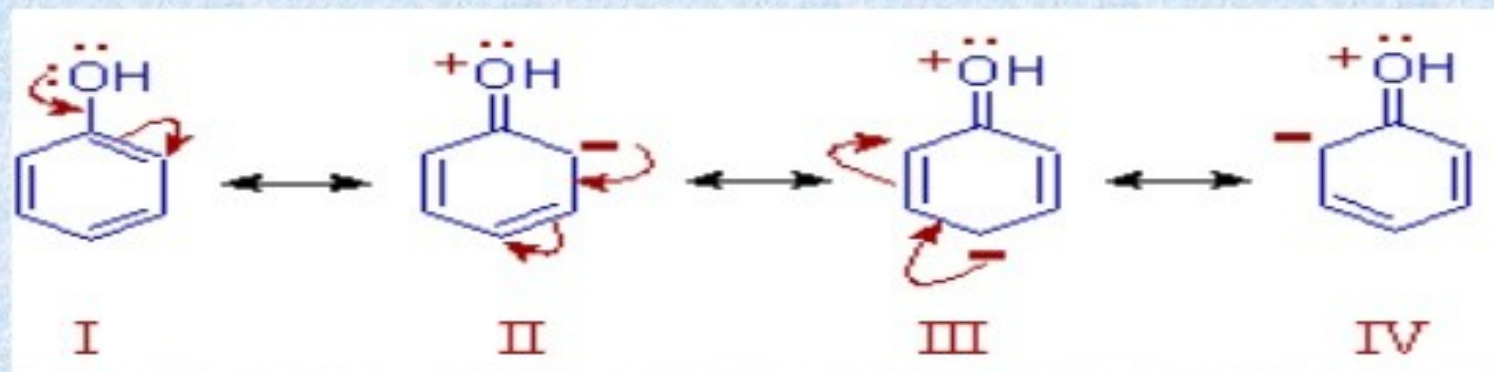


1. The nitro group, $-\text{NO}_2$, in nitrobenzene shows -M effect due to delocalization of conjugated π electrons as shown below. Note that the electron density on benzene ring is decreased particularly on ortho and para positions.



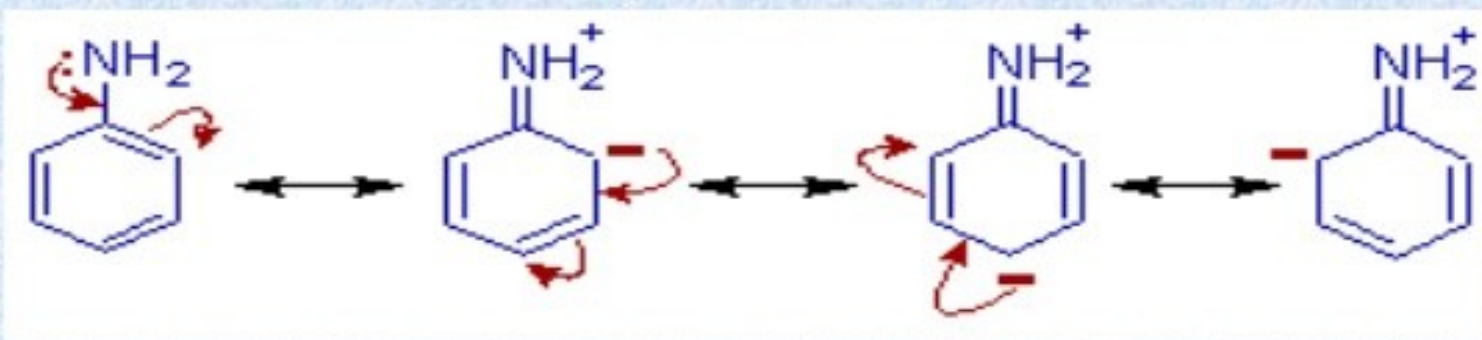
- This is the reason for why nitro group deactivates the benzene ring towards electrophilic substitution reaction.

2) In phenol, the -OH group shows +M effect due to delocalization of lone pair on oxygen atom towards the ring. Thus the electron density on benzene ring is increased particularly on ortho and para positions.



Hence phenol is more reactive towards electrophilic substitution reactions. The substitution is favored more at ortho and para positions.

3) The -NH_2 group in aniline also exhibits +R effect. It releases electrons towards benzene ring through delocalization. As a result, the electron density on benzene ring increases particularly at ortho and para positions. Thus aniline activates the ring towards electrophilic substitution.



It is also worth mentioning that the electron density on nitrogen in aniline decreases due to delocalization which is the reason for its less basic strength when compared to ammonia and alkyl amines.

SIGNIFICANCE

- It describe the charge distribution in a molecule ,thus provide an effective way of determing the point of attack of electrophiles and nucleophiles.
- Useful in explaining physical characteristics
- i.e bond length,dipole moment.



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